

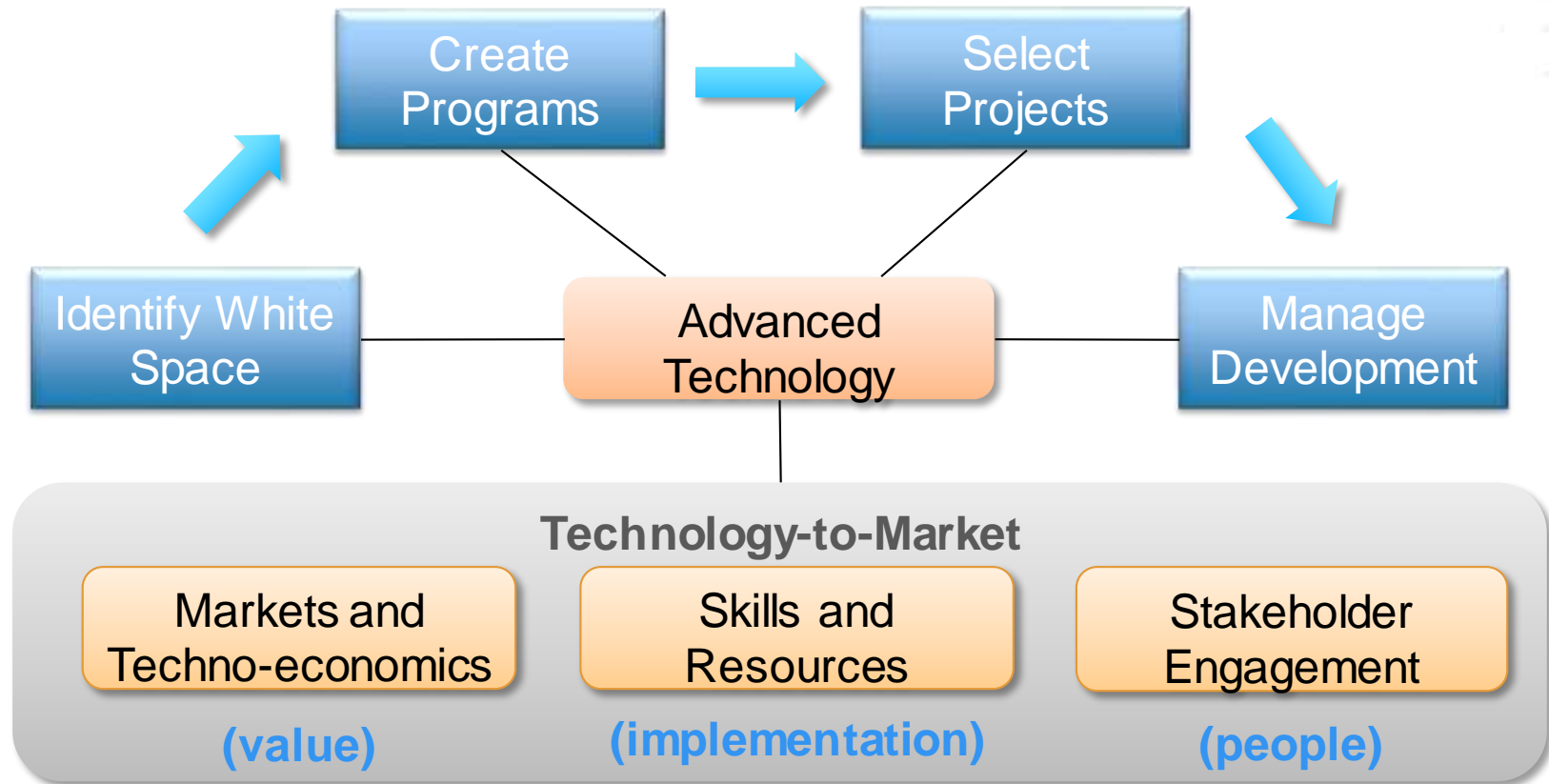
Introduction to Technology Toward Market

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October 14th, 2015

Tech-to-Market Approach

- ▶ Think from the end backwards



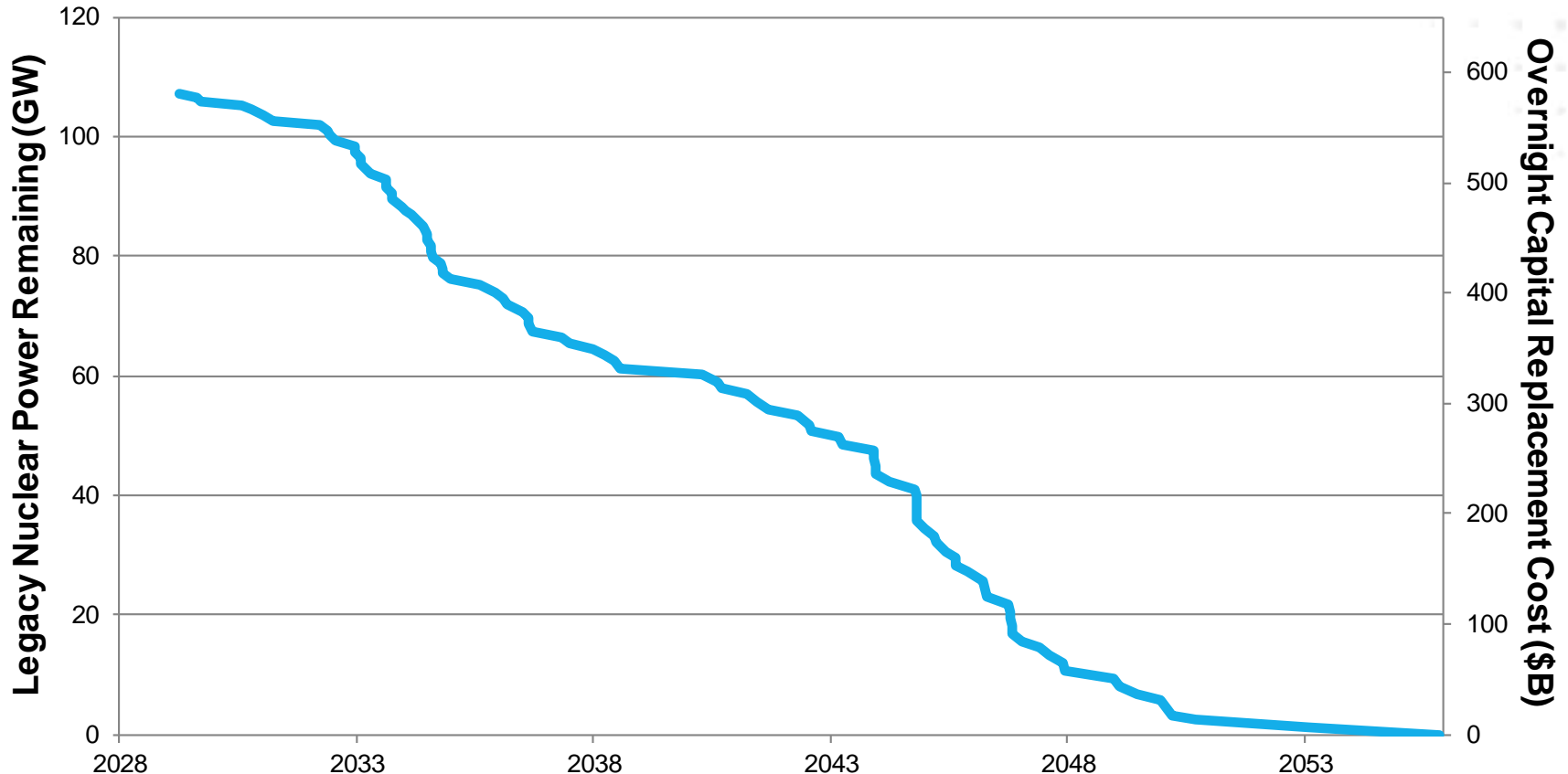
- ▶ **Goal: Increase the yield of good ideas that become technology that matters**

Why Now? (1 of 2)

- ▶ Growing calls from local, state, federal, and international groups to approach carbon-neutrality by 2050:
 - Seattle: carbon-neutrality by 2050
 - California: reduce emissions by 80%+ below 1990 levels by 2050
 - Denmark: de-carbonize by 2050
 - US EPA: reduce power plant emissions by 32% relative to 2005 by 2030

Why Now? (2 of 2)

Nuclear Retirements – The Opportunity

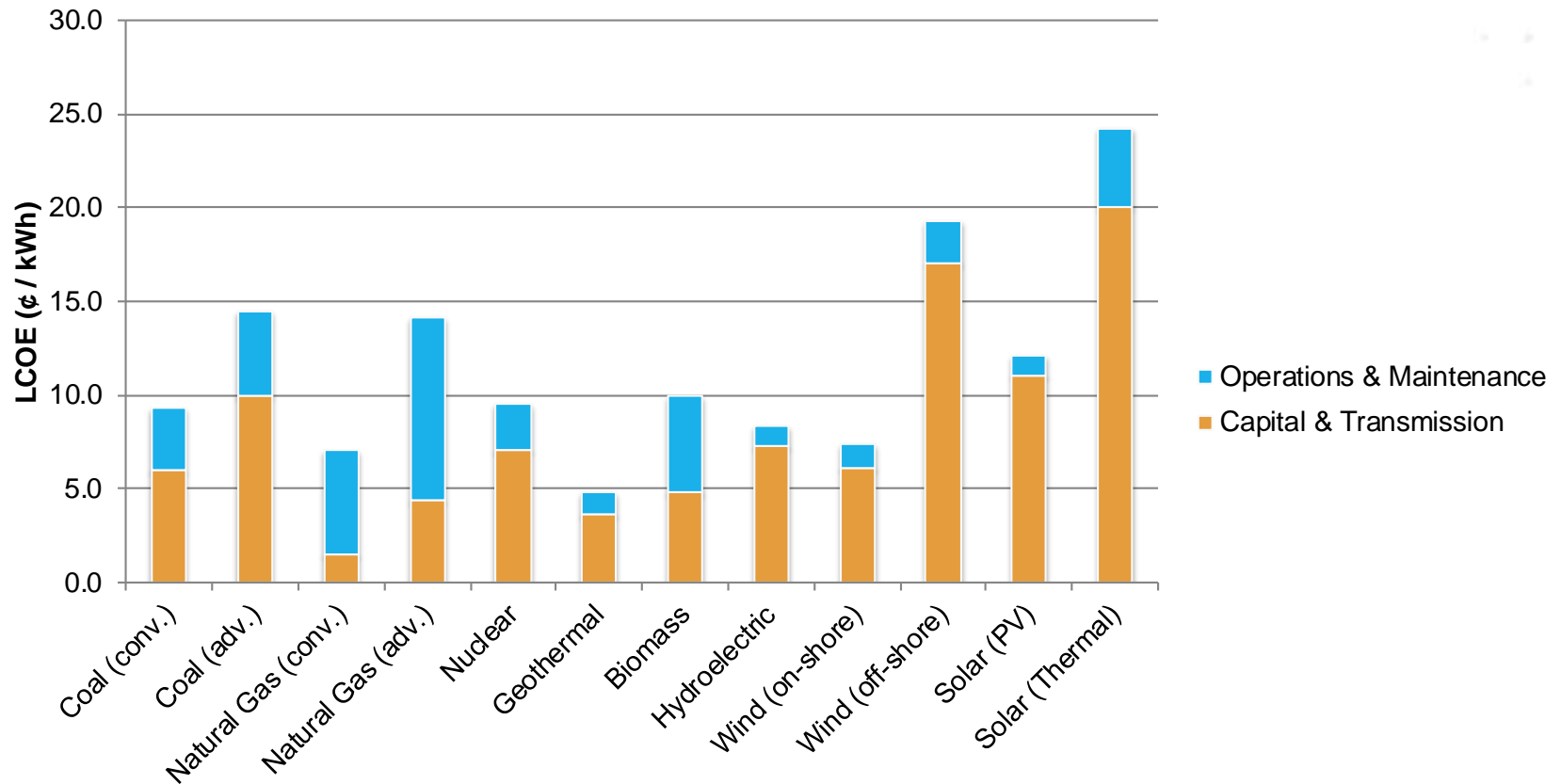


Refs: 1. NRC Information Digest (NUREG-1350, Volume 26), Appendix A: U.S. Commercial Nuclear Power Reactors - Operating Reactors
2. Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants, US Energy Information Administration, April 2013

Why Now?

Challenges to Capitalizing on the Opportunity

- ▶ Limitless, clean, safe electricity production is good...but not sufficient
 - Must achieve competitive levelized cost of electricity (LCOE)



Wind and Solar vs Fusion

- ▶ Fusion advantages:
 - Inherently baseload (directly displaces fossil or nuclear plants)
 - Small footprint relative to utility-scale wind or solar plants
- ▶ Renewable advantages:
 - Wind / solar electricity production already cost-competitive
- ▶ ...But they need energy storage to serve baseload energy requirements
 - Adds \$1-2/W on top of \$2-4/W capital cost → ~50% increase in LCOE



Powerwall

\$3,000 for 7 kWh, 2 kW, 10 yr battery
\$430 / kWh capital cost for energy
\$1.50 / W capital cost for power

Regulatory Considerations

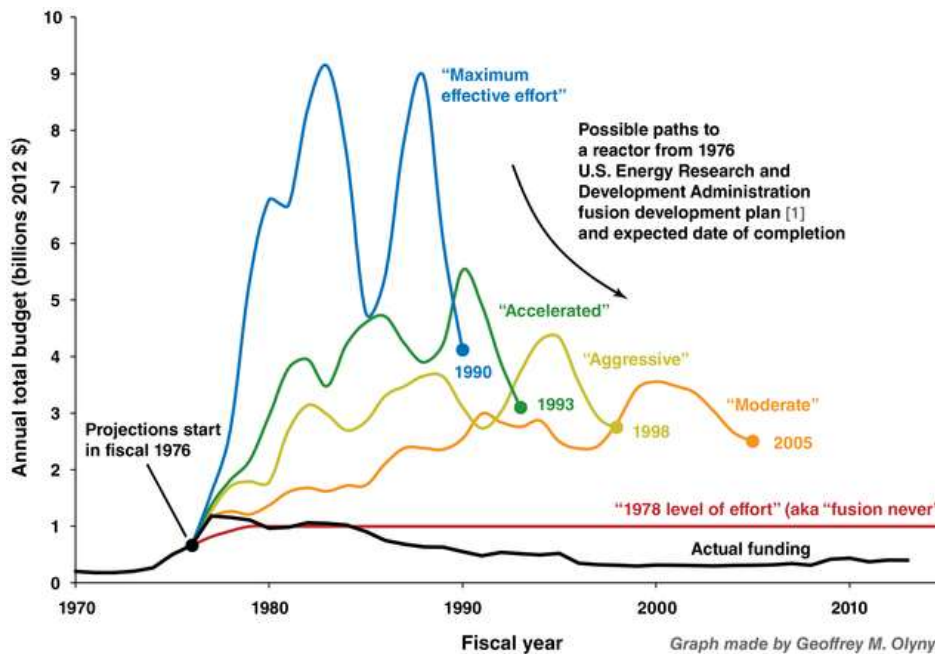
- ▶ Nuclear Regulatory Commission addressed regulatory landscape for fusion devices in 2009 (memo SECY-09-0064)
 - NRC is likely to have regulatory jurisdiction
 - Staff should wait until commercial fusion is closer before expending resources to develop regulatory framework
- ▶ Could leverage groundwork from ITER licensing in France
- ▶ Notes on NRC:
 - GAO estimates \$1-2B / ~10 yrs for development & certification of a new fission reactor
 - 90% of NRC budget is from fees (only 10% from Govt)
 - Current annual license fee: \$5M per reactor

Public Communications

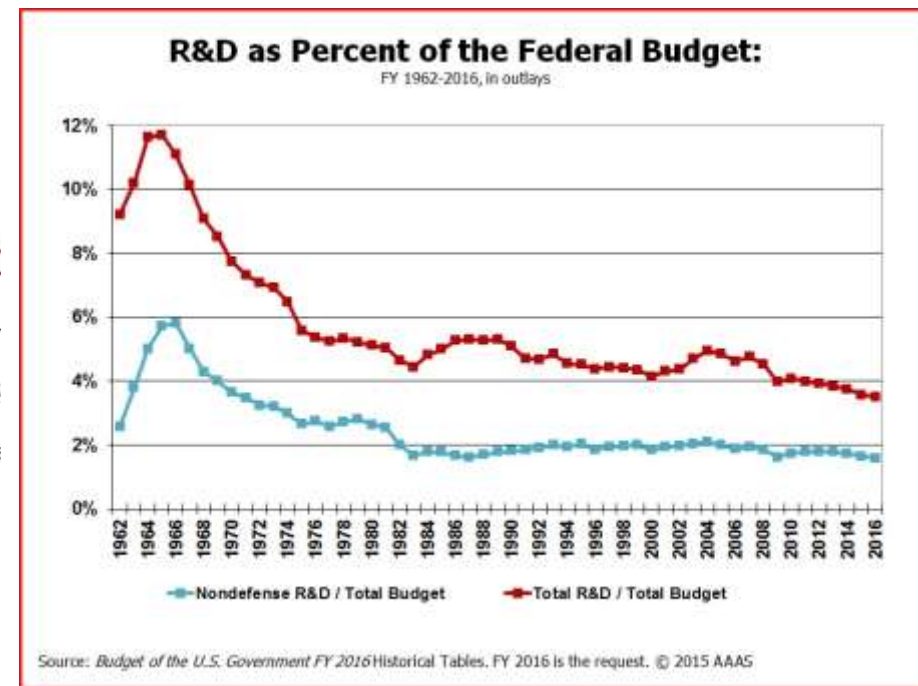
- ▶ Public perception of fusion: “the most notorious example of an ever-receding innovative achievement” (V. Smil, IEEE Spectrum, Aug 2015)
- ▶ Know your desired outcome for publicity
- ▶ Overpromising can come back to haunt you
- ▶ Evidence-based passion is good; faith-based eccentricity is dangerous

Related: Collaborative Exercise for ALPHA teams on Day 2

Federal Funding & Fusion



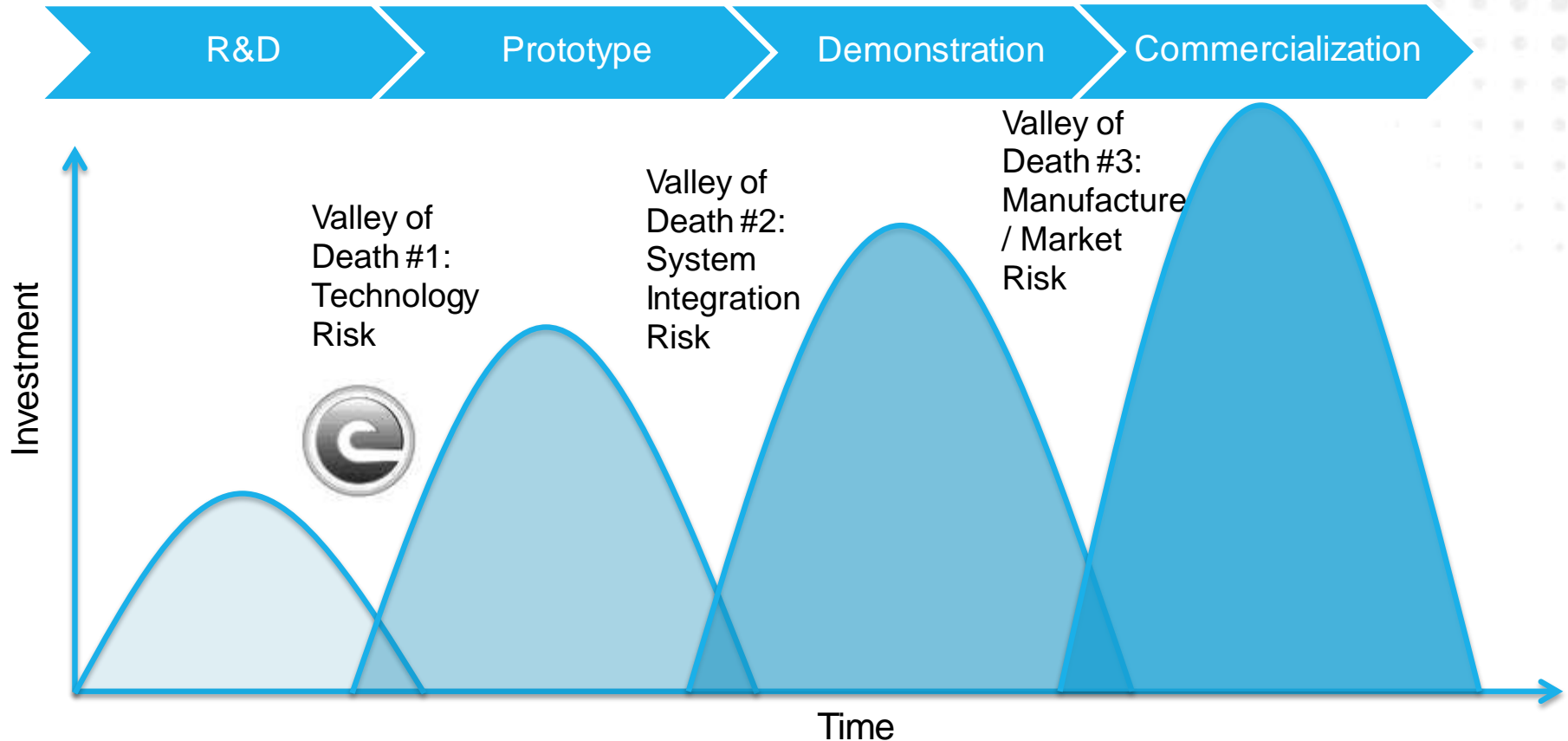
[1] U.S. Energy Research and Development Administration, 1976. "Fusion power by magnetic confinement: Program plan" ERDA report ERDA-76/110. Also published as S.O. Dean (1998), *J. Fus. Energy* 17(4), 263-287, doi:10.1023/A:102181590906



Reference points: Moonshot was ~ \$100B over ~ 1 decade (in 2010 dollars)

Manhattan project was ~ \$24B over ~ 3 years (in 2010 dollars)

Technology *Towards* Market



- ▶ Resources for teaming, intellectual property, finding funding, and general commercial readiness are available on the ARPA-E website:
 - Engage → Tech-to-Market → General T2M Resources
 - <http://arpa-e.energy.gov/?q=arpa-e-site-page/general-t2m-resources>



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Feb. 29 - Mar. 2, 2016 | Washington, DC

Summit Programming of Interest

▶ Panel Discussions:

- Summit will include multiple breakout sessions focused on current trends and best practices in technology commercialization

▶ Networking Sessions:

- *Government Agency Networking*: Representatives from 15-20 federal offices will attend a structured networking session to discuss funding opportunities
- *General & Industry-Specific Networking Receptions*: Multiple opportunities to network with investors, corporate executives and other attendees

▶ Student Program:

- 100 selected graduate-level students will be invited to attend the Summit and participate in student programming. Application deadline is December 4.

Awardee Participation



Awardees contracted as of **October 15, 2015** are required to attend and exhibit at the 2016 Summit



Summit is a key part of ARPA-E's Tech-to-Market approach

- Summit connects awardees with financial institutions, government agencies and companies looking for partnership opportunities



Engagement and learning opportunities at the Summit include:

- Targeted **networking receptions**
- **Panel discussions** on best practices in commercialization, trends in technology development
- **Corporate Acceleration Program** pairs investors with project teams

Key Responsibilities

September -
October



Register for Tech Showcase **with eventPower** (not via public website)

November -
December



Register all members of your team participating and make travel, hotel accommodations; Plan your exhibit

January -
February



Discuss best practices for exhibiting, pitching and networking with your Program Director, Tech-to-Market advisor

Feb. 29 –
Mar. 2, 2016



Attend the Summit; Provide feedback to ARPA-E on your experience



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